"ALARA"
Laboratory Performance Requirement LPR402-702.0

Radiological work shall be conducted such that radiation doses resulting from the work are as low as reasonably achievable (ALARA).
The ALARA principle is not a dose limit, but an optimization process. Its objective is to maintain doses as far below the applicable limits as is reasonably achievable, taking into account social, technical, economic, practical, and public policy considerations.

1.0 Introduction/Purpose/Applicability

This document establishes requirements that implement "ALARA," LPR402-702, and shall apply to all personnel at the Laboratory who work with radioactive material or use ionizing-radiation-producing devices.

This LIR replaces
- PED107-01, "Occupational ALARA Program,"
- LS107-05, "Radiological Performance Goals Program,"
- LS107-08, "Radiological Administrative Control Levels,"
- LP107-09, "ALARA Review of Radiological Jobs,"
- LP107-13, "ALARA Reviews of Radiological Designs,"
- LP107-14, "Employee ALARA Suggestion Program,"
- LP107-15, "ALARA Program Assessment," and
- LP107-16, "Optimizing ALARA Protection Measures (APMs)."

2.0 References

2.1 Key Words

administrative control levels
ALARA
ALARA committee
ALARA goals
optimization

2.2 Definitions

Standard radiation protection definitions can be found in "Radiation Protection Glossary" on line (click here) or in Appendix G of the Laboratory Performance Requirements.

potential for exposure—a basis for determining the effort to apply a graded approach to the ALARA program. The table in Attachment 1 shows how organizations and facilities are categorized.

routine radiological work—work that is performed repetitively, or a recurring process or operation that incorporates standard radiation protection requirements and practices based on experiences with the existing radiological conditions.

special radiological work—work that is first-time, "nonroutine," or complex and exceeds trigger levels (see Attachment 2). Special radiological work requires additional planning, review, and determination of necessary radiation protection precautions to be provided for the worker's safety.

2.3 Related Documents

"ALARA," Laboratory Performance Requirement LPR402-702
"Facility Management and Administration," LPR280-02-00-00
"Occupational Radiation Protection," 10 CFR 835 (final rule)
"Performance Assessment," Laboratory Performance Requirement LPR402-709
"Radiological Design and Control," Laboratory Performance Requirement LPR402-705
"Records," Laboratory Performance Requirement LPR402-715
"Training," Laboratory Performance Requirement LPR402-718
"Work Planning," Laboratory Performance Requirement LPR402-720

2.4 Directory of Resources

Radiation Protection Services (ESH-12), 7-5296
Dose Optimization Team (ESH-12), 5-8771

2.5 Document Ownership

The Office of Institutional Control (OIC) for this document is ESH-12, Radiation Protection Services.

3.0 Responsibilities

The responsibilities for implementing the ALARA policy are as follows:

Who	Shall
3.1 Division director, program director, or office director	• Support and promote ALARA policy and principles. • Ensure that Laboratory and organization ALARA program requirements are met. • Ensure that adequate personnel and resources are available to implement ALARA programs.
3.2 Group leader	Ensure that assignments and actions are taken to fulfill "necessary" program elements as described in Attachment 1.
3.3 Individual radiation workers	Maintain radiation exposures ALARA by applying ALARA training: • observe all radiological warning signs; • obey instructions given in work permits, pre-job briefings, and instructions from radiation protection personnel; • review annual radiation dose and monitor doses as needed while engaged in radiation work activities, to prevent inadvertently exceeding radiological goals based on legal limits or administrative exposure control levels; and • report radiation concerns to a supervisor and/or the radiation protection personnel.

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3.4 ALARA coordinator (organizations with high dose potential) and/or ESH-1	• Review plans for nonroutine radiation work that has a potential for medium or high dose, and integrate the appropriate ALARA measures into the work. • Maintain ALARA documentation in accordance with the records requirements of "Records," LPR402-715. • Ensure that training, operations, procedures, maintenance, facility designs, and emergency response plans incorporate ALARA considerations according to LPR402-702 requirements.
3.5 Line organization ALARA committee (organizations with high dose potential)	• Review the organization's overall implementation of the ALARA Program, including results of reviews and audits, trends in radiation exposure for completed work, and ALARA plans and goals for future radiation work. • Recommend to the group or division leader improvements and initiatives that are needed to demonstrate a successful ALARA program. • Meet according to a predetermined schedule and document the proceedings of the meeting.

4.0 Requirements

4.1 Introduction

Radiological work at Los Alamos National Laboratory shall be conducted in accordance with "ALARA," LPR402-702, so that radiation doses resulting from the work are *as low as reasonably achievable*.

The ALARA Program applies a graded approach, so the scope of the program is commensurate with the potential for radiation exposure. Organizations have been categorized according to high-, medium-, and low-dose criteria. The degree of participation in program requirements depends on how the organizations have been categorized. This document describes the minimum requirements for a graded approach to ALARA. Additional measures and ALARA actions may be implemented as necessary at the discretion of organizations performing the work, relying on the support of ESH radiation protection personnel.

The basis for determining the effort that must be applied to the graded program is shown in Attachment 1.

4.2 Policy and Management Commitment

Management commitment to the ALARA Program is a critical element for ensuring its success. Affected group leaders shall support ALARA principles and programs. Such support includes establishing expectations and accountabilities for superior performance in maintaining exposures ALARA. Support also includes allocating resources and providing for training so radiation workers (also called radiological workers) are qualified to apply ALARA practices. Affected owning division directors, facility managers, and support service providers shall also support the ALARA Program, as appropriate for their respective responsibilities and authorities.

ALARA

4.3 Training

An individual's ALARA training shall be commensurate with the individual's assigned role in the workplace, whether it is general employee, radiation worker, radiological control technician, manager, or supervisor. The individual shall be trained in accordance with the requirements of the Laboratory radiation protection training program as described in "Training," LPR402-718.

4.4 ALARA Procedures

ALARA procedures provide direction for maintaining occupational exposures ALARA commensurate with expected radiological conditions. Organizations shall address radiologically significant processes, operations, or experiments in their work procedures. If their activities are likely to *exceed*

- 1 person-rem collective,
- 500 mrem individual, or
- 100 mrem average,

their procedures shall be developed with provisions for reducing radiation exposure and the potential spread of radioactive material.

4.5 Administrative Control Levels

Administrative control levels (ACLs) are established to maintain personnel radiation exposures below the regulatory limits. The Laboratory annual ACL for total effective dose equivalent is set by the Radiation Protection Program manager based on recommendation from the Laboratory ALARA Steering Committee. Approval to exceed an ACL can be granted by the Radiation Protection Program manager when documentation has been presented demonstrating that alternatives were not reasonable or possible.

4.6 ALARA Goals

ALARA goals are developed as a tool to measure performance and to encourage improvement. Group leaders shall develop their goals taking operational history and future production, maintenance, and research into consideration. Organization goals shall be specific, quantitative and realistic. As a minimum, ALARA goals shall include collective exposure for the year for each organization involved in radiation work totaling *more than*

- 1 person-rem collective,
- 500 mrem individual, or
- 100 mrem average dose.

4.7 ALARA Design Review

ALARA design reviews shall be performed in accordance with "Radiological Design and Control," LPR402-705, for modifications to existing radiological facilities and new facilities.

4.8 ALARA Reviews of Radiation Work

Formal ALARA reviews shall be carried out for radiological work or experiments that satisfy criteria established in Attachment 2 unless organization criteria exist. Attachment 2 provides requirements for the criteria to trigger an ALARA review. The process shall consist of three parts:

- pre-job planning and dose estimation,
- implementation of ALARA control measures and dose-tracking, and
- post-job review.

4.9 Optimization Methods/Cost-Benefit Methods

Cost-benefit methods are used to make decisions to ensure that the most cost-effective dose-reduction measures are implemented. Cost-benefit analyses typically apply monetary equivalents of $1,000 to $10,000 per person-rem with the recommended nominal value being $2,000 per person-rem. Optimization analysis shall be performed whenever the cost of an ALARA measure exceeds $50,000 or the collective dose to be avoided is greater than 5 person-rem.

4.10 ALARA Performance Assessment

An organization's performance in implementing ALARA program elements shall be assessed as necessary (see Attachment 1) once every three years. Reports of periodic assessment of the organization/facility ALARA program shall be reviewed by management. A closed-loop system for verifying the closure of corrective actions shall be used in accordance with "Performance Assessment," LPR402-709.

4.11 ALARA Committees and Coordinators

The need for a line organization ALARA committee and ALARA coordinator shall be commensurate with the organization's potential for radiation exposure. Attachment 1 shows the implementing requirements for determining the need for ALARA committees and coordinators.

An individual shall be assigned to be the organization ALARA coordinator, with the responsibility for implementing the appropriate program elements as described in section 3.4 and as listed in Attachment 1.

A committee shall be established as needed (see Attachment 1) to assist in implementing ALARA program elements. The committee membership and operating charter shall be determined by the line organization.

4.12 Documentation

ALARA records, such as plans, reviews, meeting notes, and training forms, that document ALARA efforts and demonstrate program compliance and adequacy shall be retained along with reports of actions taken to maintain radiation exposures ALARA. Records shall be maintained in accordance with "Records," LPR402-715.

5.0 Attachments

1. Levels for Applying the Graded Approach to ALARA
2. ALARA Reviews of Radiation Work
3. ALARA Review Checklist

Attachment 1: Levels for Applying the Graded Approach to ALARA

Category Criteria Organizations are categorized by dose potential as shown in the table below.

This level of organization . . .	performs radiation work processes that result in this annual dose:
1 (high-potential-dose)	>5 person-rem collective, >500 mrem individual, or >100 mrem average
2 (medium-potential-dose)	>1 person-rem but <5 person-rem collective, >100 mrem individual, or >50 mrem average
3 (low-potential-dose)	<1 person-rem collective, <100 mrem individual, or <50 mrem average

Implementing Requirements Depending on how an organization's operations are categorized, requirements would be implemented as shown in the table below.

Program Elements	Level 1	Level 2	Level 3
Management commitment (sec. 4.2)	Required	Required	Required
Training (sec. 4.3)	Recommended	Recommended	Optional
Procedures (sec. 4.4)	Required	Required	Optional
Administrative control levels (sec. 4.5)	Recommended	Optional	NA
ALARA goals (sec. 4.6)	Required	Required	Optional
Design reviews (sec. 4.7)	Recommended	Optional	Optional
ALARA reviews* (sec. 4.8)	Required	Recommended	Optional
Optimization methodology (sec. 4.9)	Required	Recommended	Optional
Performance assessment (sec. 4.10)	Required	Optional	Optional
ALARA committees and coordinators (sec. 4.11)	Required	Recommended	Optional
Documentation (sec. 4.12)	Required	Required	Required

* The basis for performing an ALARA review is shown in Attachment 2.

Attachment 2: ALARA Reviews of Radiation Work

ALARA Trigger Levels

Routine radiological work using RWPs and SOPs provides a convenient means to perform an ALARA review of work tasks.

A formal ALARA review is required for "special radiological work." Line management, in consultation with the ALARA coordinator, facility manager, and/or ESH-1, establishes the criteria to trigger a formal ALARA review.

The recommended radiological criteria and sample trigger levels appear below.

Note: If a group leader fails to set a specific ALARA review criteria, the sample shall apply.

Radiological Condition	Trigger Level
Estimated individual dose for a job	=500 mrem whole-body EDE =5 rem partial-body (extremity) or shallow
Estimated collective dose for a job	=1 person-rem =10 person-rem shallow
Work area airborne radioactivity concentrations	=25 DAC averaged over 8 hr (200 DAC-hrs)
Work area removable contamination levels	=1000 x Appendix A values in "Radiation Protection Program Standards," LPR402-702.
Work area dose rate	>1000 mrem/hr whole body >10,000 mrem/hr extremity

ALARA review process

The process for performing a formal ALARA review is shown below.

Step	Action
1. Do pre-job planning and estimate dose	• Detail the work and dose estimations. • Determine whether a formal ALARA review is required.
2. Implement ALARA control measures and track dose	• If a review is required, incorporate ALARA measures into the work. • Track individual and collective doses and compare to the estimated dose to determine if the ALARA measures are effective
3. Do post-job review	If actual doses fall outside the range of ± 25% of pre-job estimates, or if significant problems or successes were learned, then perform and document a formal post-job review on improvements to optimize doses for similar future work

ALARA Review Checklist

Job/Operation Title		
Purpose of Job/Operation		
RWP/SOP No.	Job/Operation Contact	SJ Ticket/WO No.

Yes	No	
		Procedures
____	____	Prepare special radiological procedures?
____	____	Include radiological control hold points?
____	____	Review abnormal and emergency procedures?
____	____	Identify where signatures or verifications are needed?
____	____	Establish success or completion criteria?
____	____	Develop pre-job collective dose estimate?
____	____	Apply special waste minimization, control, or disposal?
____	____	Establish detailed schedule for task sequencing/personnel entries?
		Engineering
____	____	Make special use of existing engineering controls?
____	____	Develop new engineering controls?
____	____	Install temporary/permanent shielding? (Include load/stress concerns.)
		Worker Preparation
____	____	Provide special radiological training?
____	____	Use mockups, walkdowns, or dry runs?
____	____	Optimize worker efficiency (comfort vs. exposure)?
____	____	Use photos/drawings/video for pre-job briefing/training?
____	____	Select most highly skilled/qualified workers?
		Job Setup
____	____	Prestage materials or tools?
____	____	Prefabricate parts/materials?
____	____	Install special services (power, water, air, ventilation)?
____	____	Post ALARA waiting/rest areas and hot spots?
		Contamination Control
____	____	Use contamination curbing, floor covering, fencing?
____	____	Use tents/glove boxes/containments?
____	____	Use catch trays/drainlines?
____	____	Use HEPA vacuums?
____	____	Install local ventilation?
____	____	Use special protective clothing/devices?
____	____	Implement special hot particle controls?
____	____	Wet or fix loose contamination?
		Exposure Control
____	____	Flush contaminated lines?
____	____	Decontaminate area? (Optimize decontamination dose vs. job dose.)
____	____	Allow for decay before entry?
____	____	Use special, remote, or robotic tools?
____	____	Can a high-dose source be removed?
____	____	Require special monitoring (e.g., CAMS, ARMS, continuous coverage)?
____	____	Move some work to low or no exposure areas?
____	____	Can work crew be reduced w/o increasing total dose?
____	____	Is there unnecessary work that can be eliminated?
____	____	Use remote, integrating, or real-time dose tracking?
____	____	Use remote audio/visual communications?
____	____	Use worker time limits?
____	____	**Is there a useful ALARA technique for this job not mentioned above?**

List detailed recommendations on back. Attach any special analyses/worksheets (date and sign).
If ALARA recommendation implementation cost is about $50K or more, provide cost-benefit analysis.

List ALARA recommendations for job identified on reverse side.

Prepared By _____ Date _____

Attach all supporting review documentation including the Formal ALARA Review Determination worksheet.
File this material with the applicable RWP/SOP package.